

Optimized Segmentation of the Crystal River Unit 3 Reactor

24143

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Orano Decommissioning Services, LLC

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Agenda

01

Introduction
Orano's worldwide presence
& U.S. Operations

02

Vermont Yankee BWR
First full segmentation of a commercial
BWR in the U.S. and innovation towards
reduced segmentation and packaging

03

Crystal River Unit 3 PWR
Orano's first implementation of the
breakthrough Optimized
Segmentation process

04

Conclusion
Main lessons learned and progress
accomplished

01 • Orano Decommissioning Services

Worldwide presence and U.S. operations

50
Years of
experience

5,000
ODS
employees

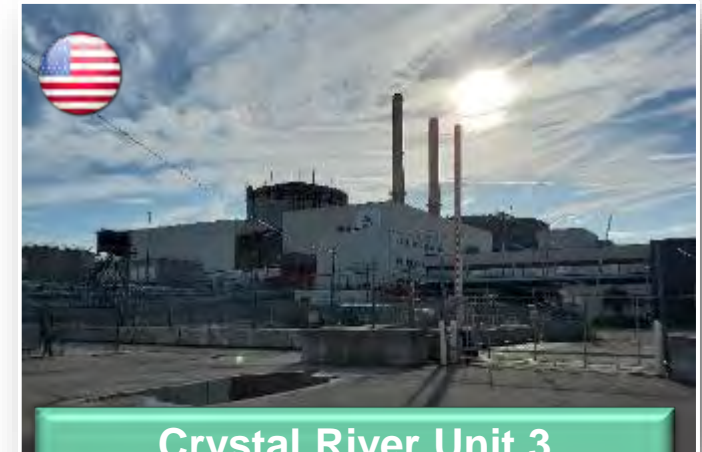
Involved in
more than
160
D&D projects
worldwide

\$600M
revenue

7
Reactor D&D
projects



Vermont Yankee
Completed in 2022



Crystal River Unit 3
Completing in 2024

02 • Vermont Yankee BWR – First Accelerated Decommissioning



Project ID

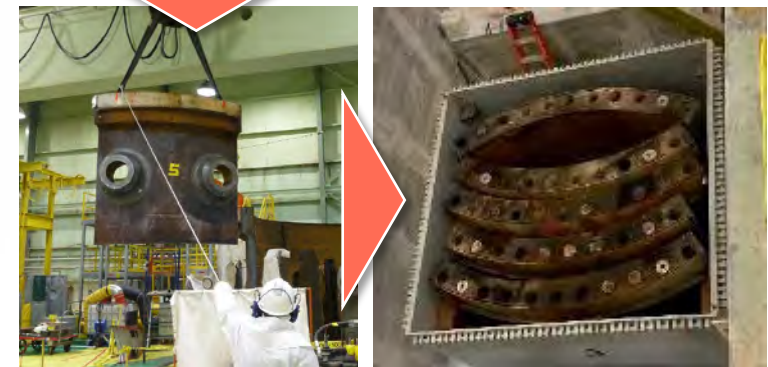
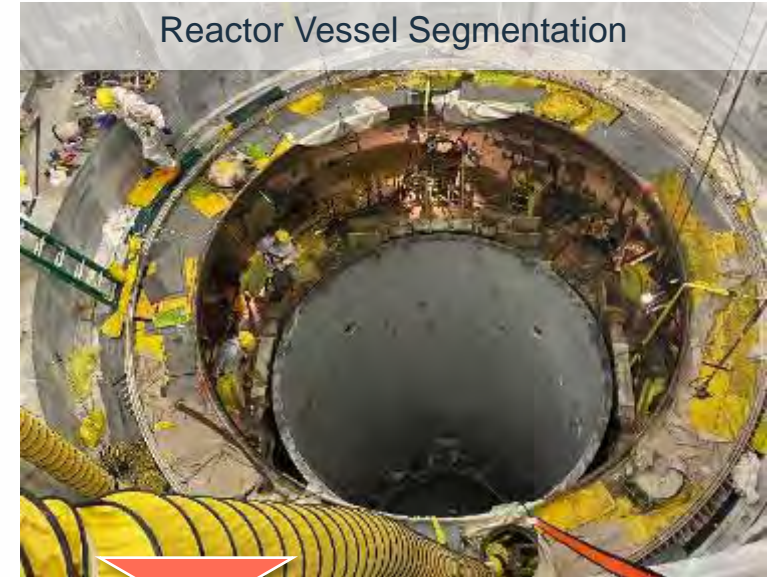


Name: Vermont Yankee
Site: Vernon, Vermont
Reactor type: BWR (620 MW)
Scope of work: RPV – RPV Internals segmentation, packaging, and transportation

- Work progress:**
- ✓ Project Kick-Off – July 2017
 - ✓ Site mobilization – March 2019
 - ✓ RVI complete – Aug 2021
 - ✓ RV complete – Aug 2022



270,000 hours of safe work without a Lost Time Accident



Reactor removal **completed** - On track for Plant Accelerated Decommissioning in **<10 years**

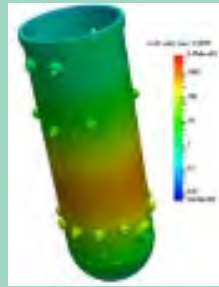
02 • Vermont Yankee BWR – Waste Synopsis

RV / RVI Components



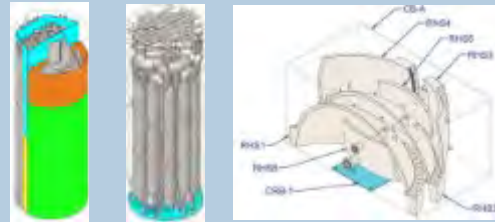
>1,200 segments

Waste Classification



- GTCC
- LLRW Class B & C
- LLRW Class A

Waste Packaging



- 1 Canister
- 7 Canisters
- 17 Custom Boxes
13 160-Liners



1st use of the MP197HB!

RV + RVI
Full Segmentation and
Packaging
in **38 Containers**



03 • Crystal River 3
860 MW PWR
Reactor and Cooling System
Segmentation, Packaging,
Transportation, and
Disposal Project

**Orano successfully
deploys its patented
“Optimized
Segmentation” for
the first time**



03 • Crystal River 3 – Optimized Segmentation and Packaging Plan

Head Removal and Packaging

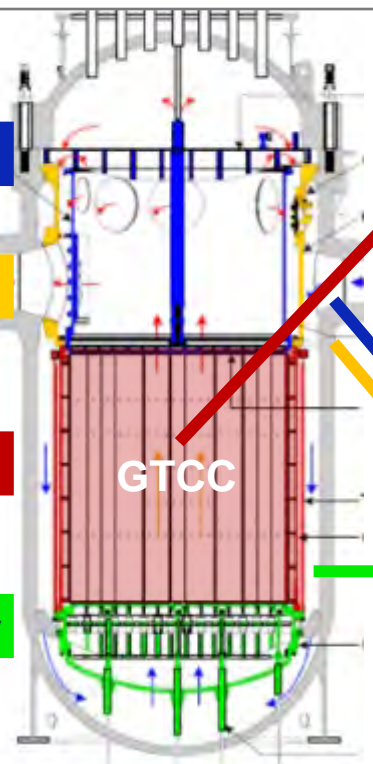


Plenum Assembly

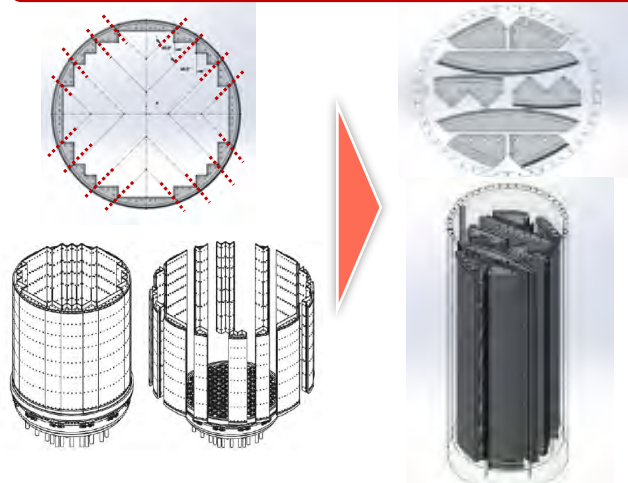
Core Support Shield

Core Barrel Assembly

Lower Internals Assembly

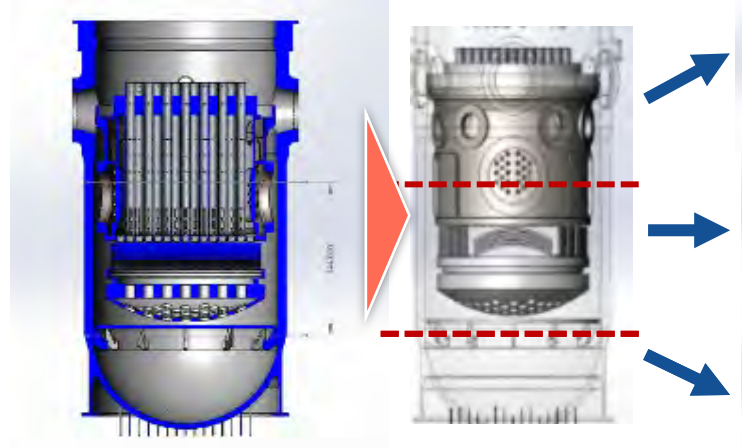


GTCC reactor components packaged in 2 RadWaste Canisters for onsite ISFSI storage



- 1 AIR OUTLET
- 2 SHIELDED DOOR
- 3 AIR INLET
- 4 SHIELD PUG
- 5 GRAPPLE ASSEMBLY
- 6 HYDRAULIC RAM
- 7 TRANSPORT TRAILER
- 8 STORAGE MODULE
- 9 DRY STORAGE CANISTER
- 10 ONSITE TRANSFER CASK
- 11 BASEMAT
- 12 APPROACH SLAB
- 13 CASK SUPPORT SKID AND POSITIONING SYSTEM

Balance of reactor components repositioned inside the vessel and grouted. Vessel is segmented and packaged in 3 custom shipping containers for off-site disposal



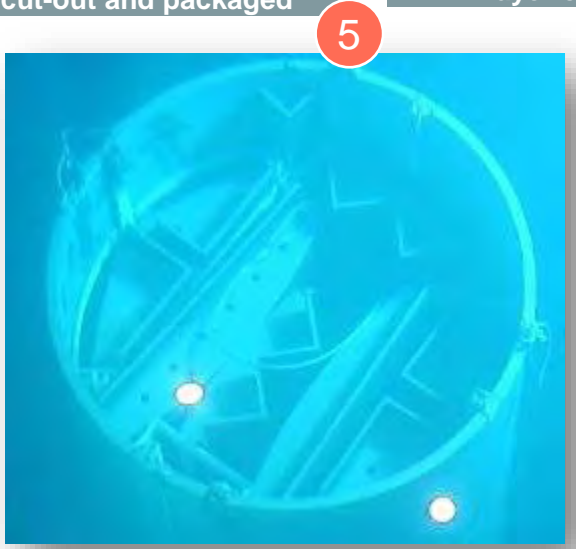
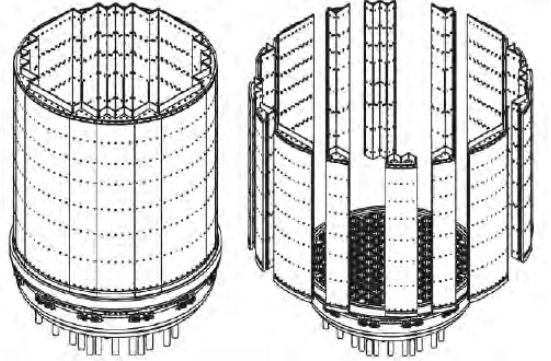
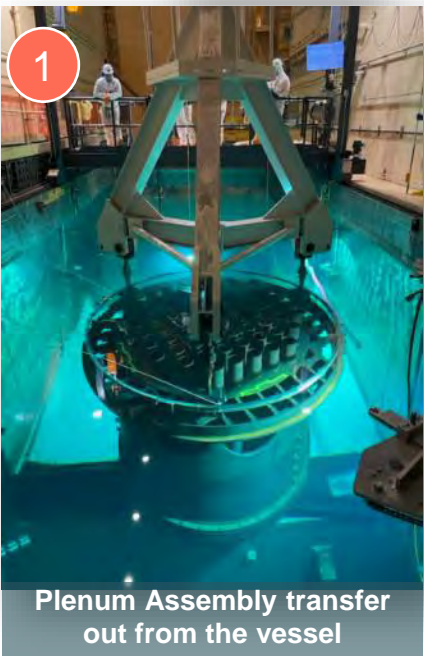
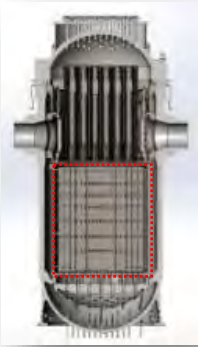
- Class A** Ø19' x h 13' 608,000 lbs.
- Class B/C** Ø17' x h 15' 716,000 lbs.
- Class A** Ø17' x h 7' 184,000 lbs.



03 • Crystal River 3 – Reactor removal – GTCC extraction from the RVI

2020 **2021 – Cooling System Removal** **2022 – GTCC Removal** **2023 – Vessel Removal**

Project start
Oct. 2020



03 • Crystal River 3 – Reactor removal – RVI immobilization inside the RV

2020

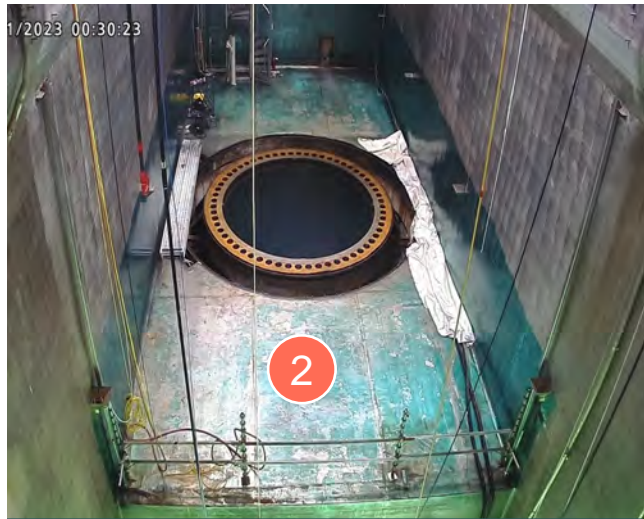
2021 – Cooling System Removal

2022 – GTCC Removal

2023 – Vessel Removal

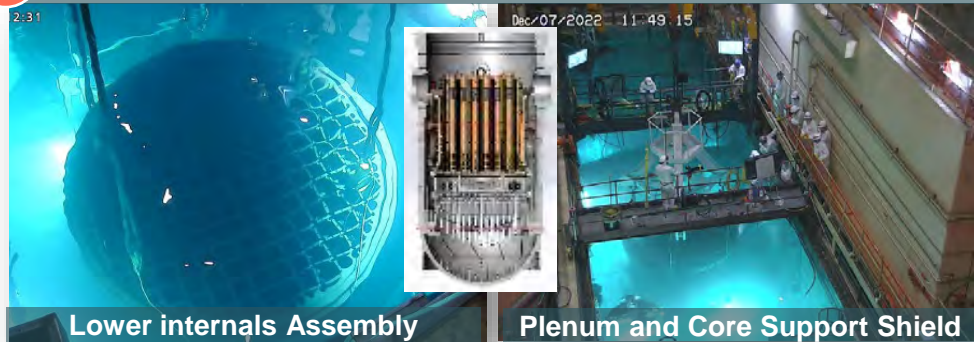
Reactor Vessel Removal:

1. Internals repackaging inside the vessel
2. Fuel transfer canal cleanup and drain down
3. Reactor vessel grouting and segmentation

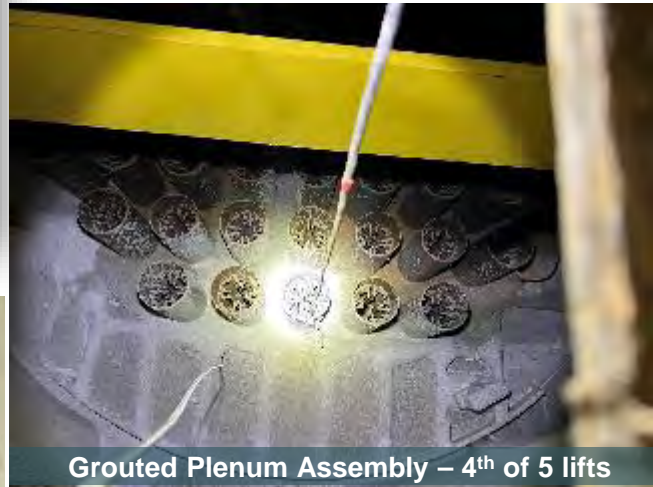
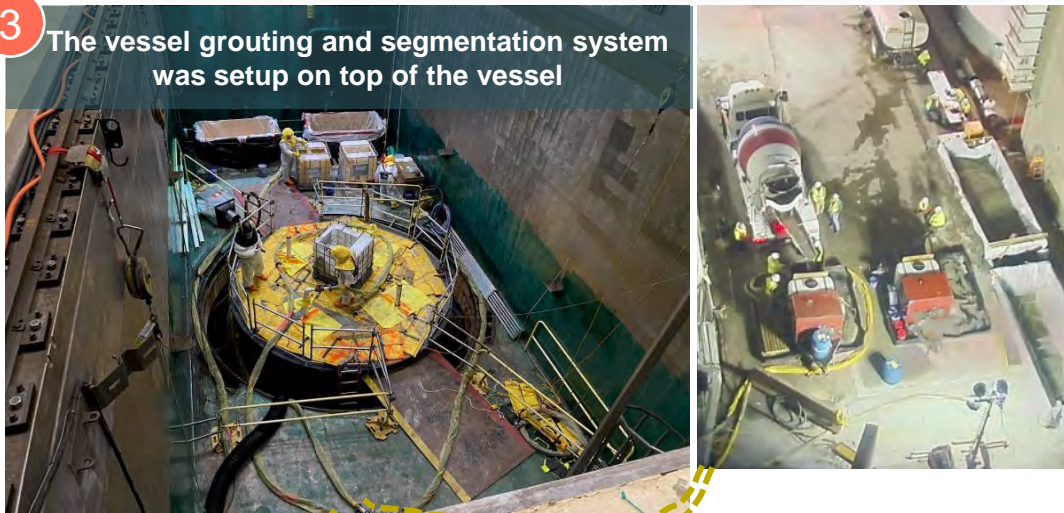


All RVI underwater activities were completed, and the Fuel Transfer Canal was cleaned up and drained down to prepare for RV dry segmentation work

1 Non-GTCC internal components were repositioned inside the vessel



3 The vessel grouting and segmentation system was setup on top of the vessel



Grouted Plenum Assembly – 4th of 5 lifts

The internals were immobilized inside the vessel by pumping a low-density cellular concrete developed by Orano, inside the vessel from outside the reactor building



03 • Crystal River 3 – Reactor removal – Segmentation and Packaging

2020

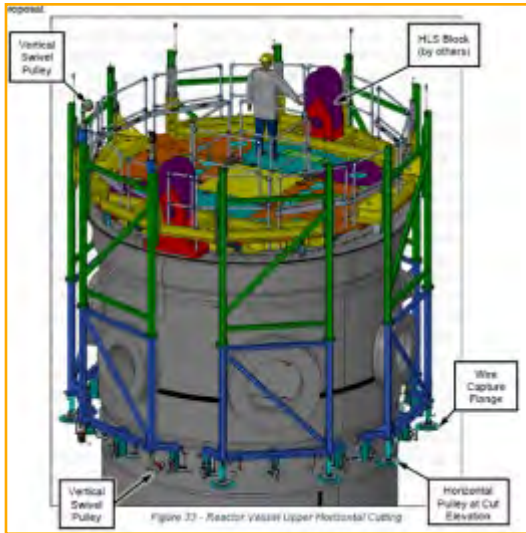
2021

2022

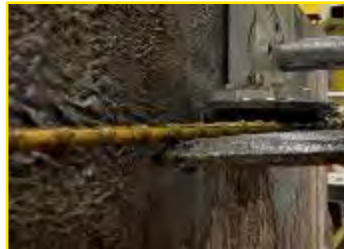
2023 – Vessel Removal

Reactor Vessel Removal:

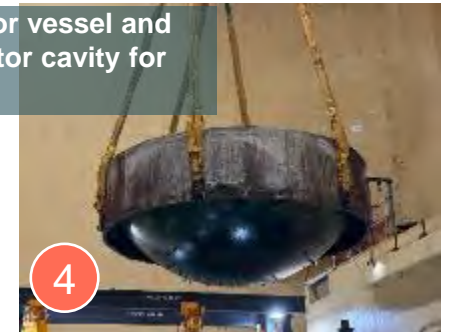
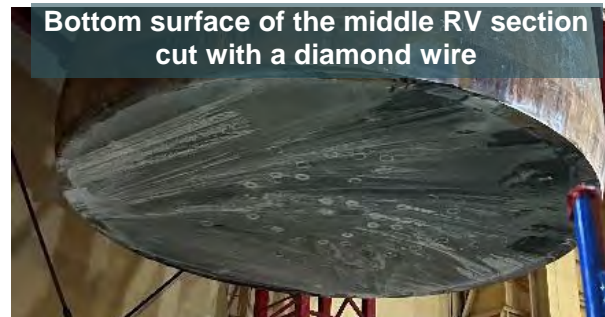
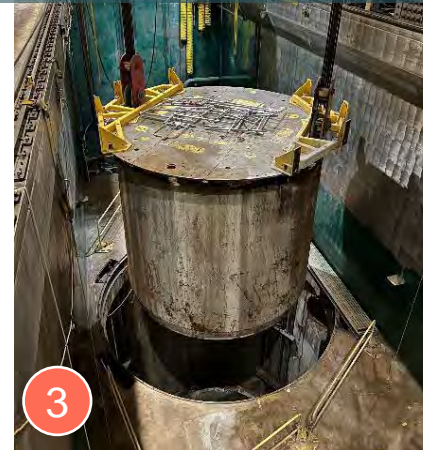
1. Reactor vessel segmentation
2. Top section removal
3. Middle section removal
4. Bottom section removal



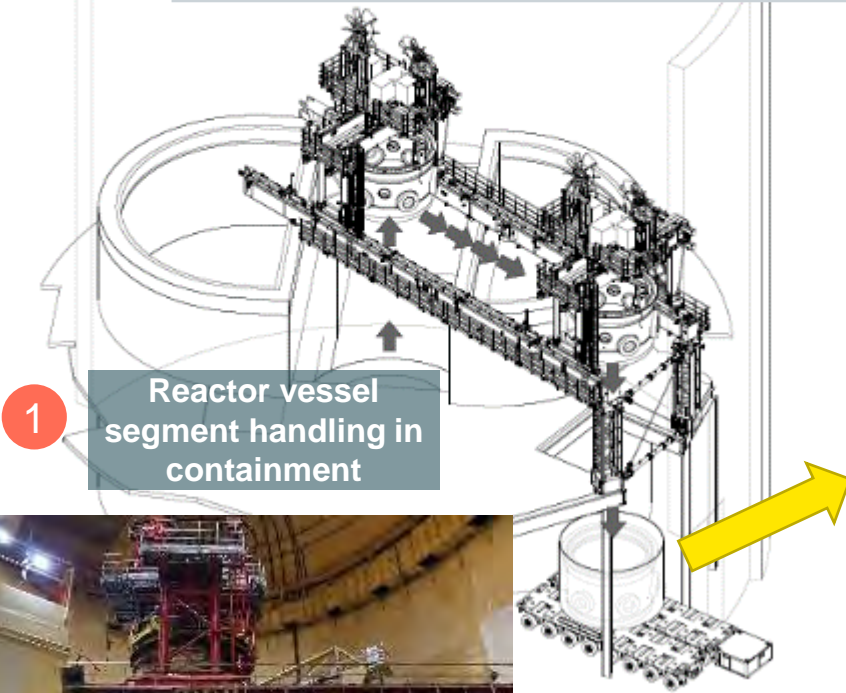
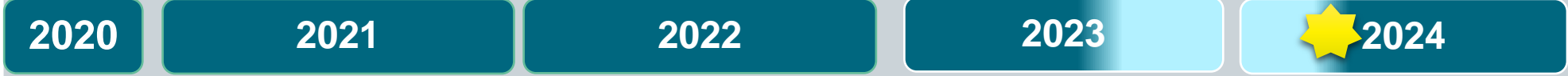
1 The RVR/VI monolith was separated from the RCS piping and segmented in 3 sections using Diamond Wire Sawing and thermal cutting



Top, middle, and bottom section of the reactor vessel and internals separated and lifted out of the reactor cavity for packaging and shipment



03 Crystal River 3 – Reactor Packaging and Shipment for Disposal



1

Reactor vessel segment handling in containment



RV Type B package loaded with the middle RV+RVI segment



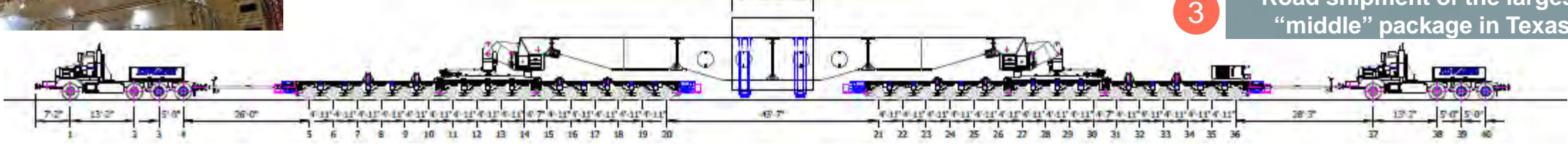
2

Barge shipment from Florida to Texas



3

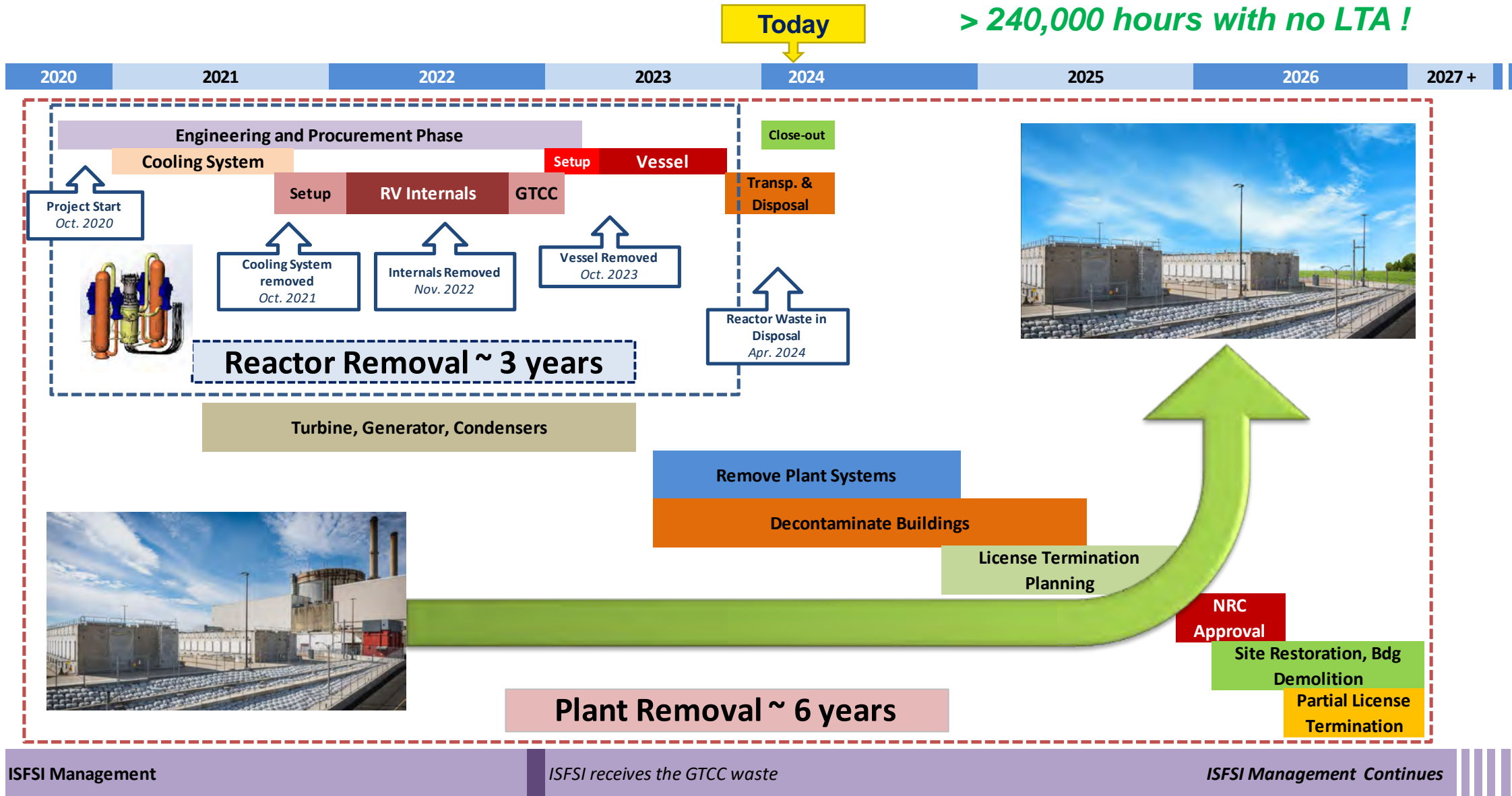
Road shipment of the largest "middle" package in Texas



03

Crystal River 3 – Execution Timeline

> 240,000 hours with no LTA !

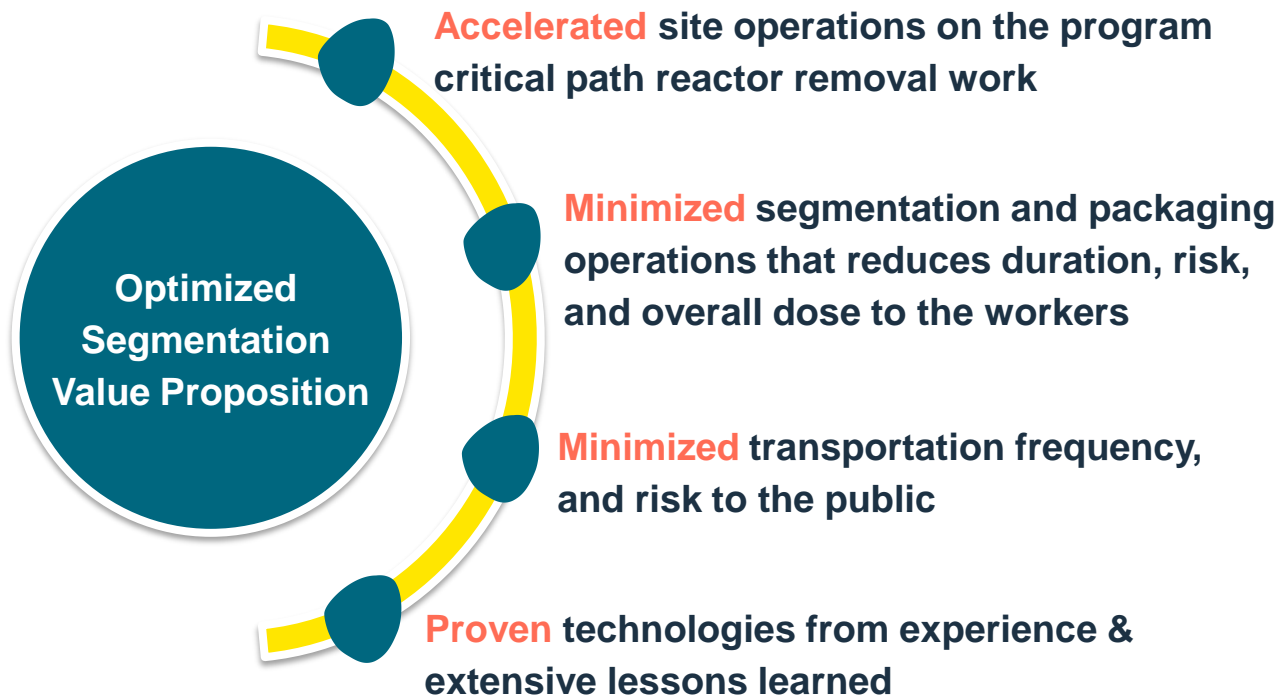


04 Conclusion – Main Lessons and Progress Accomplished

Innovating for enhanced safety and efficiency

Orano has enhanced its processes and expanded its toolbox and options offered to the industry, with access to larger packaging systems and minimized segmentation work.

At Crystal River 3, Orano performed its first implementation of the Optimized Segmentation **breakthrough** strategy, and achieved safety, performance and regulatory goals.



| Number of LLW Packages / Shipments for the Reactor Components | |
|---|-----------|
| Typical BWR / PWR Full Segmentation | ~ 50 - 80 |
| Vermont Yankee BWR Full Segmentation | 38 |
| CR3 PWR Optimized Segmentation | 6 |





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Giving nuclear energy its full value